UNITED STATES DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION
WASHINGTON 25, D. C.

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TELEPHONE ENGINEERING MEMORANDUM 517

SUBJECT: Preparation of Telephone System Plans and Specifications

After approval of the area coverage design and execution of the loan contract by the borrower and the Administrator, the plans and specifications for construction of project are to be prepared by the borrower's engineer and, after having been approved by the borrower and reviewed by the REA field engineer, two copies are to be submitted to the REA Section Engineer for review and approval.

Unless the borrower's engineer has determined the quantities of the various kinds of units of construction from a tabulation of the staking sheets prepared by him for the construction of the project, it will be necessary for him to prepare a detailed study and construction analysis of the project to be used as a basis for his estimate of the quantities of the various kinds of construction units required. This memorandum has been prepared to assist the borrower's engineer. When a detailed study and construction analysis of a project is required these data should be presented in a logical and orderly manner. The sample data sheets illustrated and explained herein have been used successfully by several engineering firms. They are presented as a suggested guide only and may be modified as needed by the borrower's engineer to fit his particular requirements.

1. Scope of the Plans and Specifications

The plans and specifications for construction of a project may be for all, or any part, of the system provided for in the loan contract. Construction not provided for in the loan contract shall not be included in the plans and specifications without prior REA approval. The plans and specifications are to be based on the approved area coverage design and any deviations therefrom must be satisfactorily justified by supporting data.

2. Maps and Construction Drawings

Each set of plans and specifications shall include one, or more copies if necessary, of all maps (key, detail, town, etc., prepared in accordance with REA mapping standards) and construction drawings required for the construction of the project.

(a) The key map shall show:

1. Location of lines to be constructed.

2. Location of lines which have not been staked.

3. Location of lines for which easements have not been procured.

4. Location of lines where right-of-way has been cleared.

5. Consecutive designation of areas by numbers or otherwise to show the sequence of construction desired.

6. Location of central offices.

7. Location of existing lines included as part of the proposed new system.

8. Location of existing lines to be retired.

(b) The detail and town maps shall show:

1. Location of lines to be constructed.

2. Location of existing lines included as part of proposed new system.

3. Location of existing lines to be retired.

4. Location and classification of subscribers.

(c) Complete construction drawings for each type of unit of construction with specifications outlining the method of construction and the material to be used shall be included with the plans and specifications. Where nonstandard units of construction are specified (such as underground conduit systems, etc.) special construction drawings must be prepared by the engineer and submitted for REA approval. Where standard assembly units of construction are specified for which approved construction drawings are available such as those shown in "Telephone System Construction Contract," REA Form DS-T-10, copies of such approved drawings are to be used.

3. Quantitative Study and Construction Analysis

The borrower's engineer shall submit in duplicate with the plans and specifications a detailed study, including basic design data, of the quantities, kind, type, size, and capacity of the materials on which

the plans and specifications are based unless the quantities of the various kinds of units of construction are determined from a tabulation of the staking sheets. In order that the detail study may be somewhat standardized, the following outline has been prepared as a guide for the preparation of these data.

(a) Summary of Construction (Sample Basic Data Sheet No. 1)

From the maps of the project referred to above the engineer shall prepare a complete summary of new line construction showing the route miles of the various types of line classified as to:

1. Number of circuits - initial and ultimate.

   The initial number of circuits should satisfy the requirements of the loan contract applicable to the scope of the project. The ultimate should provide for area coverage as established in the area coverage design.

2. Conductor size and type.

   Cable should be classified as to pairs, gauge, etc., using standard mapping symbols. Open wire should be classified as to size and type also using standard mapping symbols.

3. Pole top fixtures.

   Indicate pole top fixtures as follows:

   2B = Two brackets

   2P = Two pin crossarm

   6P = Six pin crossarm

   10P = Ten pin crossarm

   Where two crossarms are required show as 10P6P, or 10P10P, etc. Where one crossarm is initially required with space for a second arm to be installed later show as 10PS.

4. Base pole height and class.

   The base pole selected should have sufficient pole strength and height for the ultimate number of circuits in each case to meet the code requirements for the

loading zone in which the system is located. The most economical selection of base pole should be made after taking into consideration all factors such as maximum utilization of conductor strength, the effect of terrain on the cost of setting poles, ground clearance requirements, etc. The engineer should submit calculation sheets to justify his selection of the base pole where such justification is required.

5. Normal span length.

A normal span length consistent with the base pole height, basic ground clearance required, and the physical characteristics of the conductor should be selected from the staking tables, supplied by the conductor manufacturer, applicable to the loading zone in which the project is located. For additional information refer to the Engineering and Construction Manual for REA Telephone Engineers.

6. Average span length.

Assume an average span length of approximately 90% of the normal span length unless staking experience indicates otherwise.

7. Poles per mile.

The number of poles per mile is determined by dividing 5280 feet by the average span length. For example, if the average span is 375 feet the number of poles per mile would be 14.1.

8. Total poles.

The total number of poles required for each classification of line is obtained by multiplying the route miles by the number of poles per mile.

9. Total circuit contacts (initial).

The total circuit contacts for any one classification of line is obtained by multiplying the total number of poles by the number of circuits (initial).

(b) Pole Unit Quantities (Sample Data Sheet No. 2)

From the "total poles" column of the construction summary the borrower's engineer can obtain the total quantity of each size and class of base pole required. This information is entered in

columns 1 and 2 (Sample Data Sheet No. 2) and the quantities distributed over the range of pole units according to the staking experience of the engineer. The quantity of each size and class of pole unit is then totaled and the totals shown at the bottom of each column. The grand total of base pole quantities should check with the grand total of the pole unit quantities.

(c) Guy and Anchor Assembly Units (Sample Data Sheet No. 3).

The selection of guys and anchors should generally be based on the ultimate number of circuits to be carried by the pole line and the type of conductor with due consideration to the other pertinent factors such as terrain, consistent with good staking practices. On pole lines where space is to be provided for a second crossarm at a later date, it will be satisfactory to guy for only the initial crossarm if the installation of the second crossarm will require a second guy. Generally, single guys will satisfy the ultimate requirements. After the total quantity of each size guy and anchor has been determined, the engineer shall determine the various types of guy and anchor assembly units of each size required based on staking experience.

(d) Pole Top Assembly Unit Quantities (Sample Data Sheet No. 4).

From the columns headed "pole top fixtures" and "total poles" of the construction summary (Sample Data Sheet No. 1) the borrower's engineer can obtain the total of each classification of pole top fixture, i.e., 2BKT, 1-6P, etc. These totals, when entered at the bottom of the respective columns (Sample Data Sheet No. 4), can then be distributed (vertically) to the various types of pole top assembly units required based on the staking experience of the engineer. The total of each type of pole top assembly unit is obtained by adding (horizontally) the quantity of that particular assembly unit appearing in each column of pole top fixtures.

(e) Pin and Insulator Assembly Unit (T) Quantities, (Sample Data Sheet No. 5).

From the column headed "total circuit contacts - initial" of the construction summary (Sample Data Sheet No. 1) the borrower's engineer can obtain the total number of "circuit contacts" for each type of line, i.e., 1 circuit, 2 circuit, 3 circuit, etc. These totals, when entered at the bottom of the respective columns (Sample Data Sheet No. 5) can be distributed (vertically) to the various types of pin and insulator assembly units required based on the staking experience of the engineer and the transposition requirements of the system. The total of each type of pin and

insulator assembly unit is obtained by adding (horizontally) the quantity of that particular type of assembly unit appearing in each of the columns including the additional quantity needed at locations where double crossarm construction is required.

(f) Wire Assembly Units (D) Quantities, (Sample Data Sheet No. 6)

From the first three columns of the construction summary (Sample Data Sheet No. 1) the borrower's engineer can obtain the total "route miles" of line classified as to number of circuits for each size and type of conductor. With this information the engineer can calculate (Sample Data Sheet No. 6) the number of wire units by size and type of wire required for the construction.

(g) Drop Wire Assembly Units (K) Quantities (Sample Data Sheet No. 7)

Based on his knowledge of the area in which the system is to be located the borrower's engineer establishes an assumed average length of service drop and based on the number of services required calculates (Sample Data Sheet No. 7) the number of drop wire assembly units of each kind of drop wire required for the construction.

(h) Cable, Loading Coils, Terminals, and Protector Assembly Quantities (Sample Data Sheet No. 8)

The use of the data sheet illustrated will greatly facilitate the calculation of the quantities of assembly units required and provide a ready means for checking these requirements. Where extensive use of cable plant is proposed the borrower's engineer should prepare a cable layout drawing on which should be located the various components properly identified. The drawing should be made to a scale of 1" = 100 ft. The assembly units specified should conform to those listed in Section (d) pages 1 to 16 inclusive of the "Telephone System Construction Contract," REA Form DS-T-10.

(i) Station Equipment Assembly Quantities (Sample Data Sheet No. 9)

It will be the responsibility of the borrower, assisted by its engineer, to determine what types of telephone sets (desk, wall, or bracket) are to be provided, or if all types are to be used, the approximate number of each type that should be provided. The use of the data sheet illustrated (Sample Data Sheet No. 9) will be helpful in tabulating these data and facilitate the review of the data by REA.

(j) Joint Use Assembly Units (N)

The borrower's engineer may include the joint use construction in his summary of new construction if it is properly identified or segregated so as to facilitate checking. The assembly units

required for joint use construction should be identified by using the letter "N" as a prefix to the assembly unit designation. A separate summary of the joint use construction may be submitted if more convenient.

(k) Rearrangement Assembly Units (W)

Due to the wide variation in the details required in rearrangement and modification of existing plant, standard data sheets for the development of these details have not been prepared. The borrower's engineer should make a careful inspection of the borrower's existing plant and determine what portion can be retained and what modifications, rearrangement, and replacements will be required to make it suitable for use as part of the proposed new system. The results of this inspection should be summarized and included as part of the detailed study and construction analysis.

(l) Removal Assembly Units (R)

In general, it is recommended that only that part of the existing plant which must be removed to make way for new construction or for other good reasons, be itemized by assembly units. Existing plant which is to be retired and can be abandoned at its present location with no loss or liability to the borrower should be mentioned in the study and a general description of that part of the plant provided for record purposes.

(m) Central Office Equipment Assembly Units

In the majority of cases the CO equipment will not be included in the line construction contract but instead will require a separate contract. In cases where CO equipment is to be included in the line construction contract each central office should be listed as a separate assembly unit by location or name, and the CO office equipment specifications and the CO requirements for each location should accompany the plans and specifications.

(n) Underground Conduit Assembly Units

Where underground conduit is to be used, the borrower's engineer must prepare detailed construction drawings of the underground conduit system to accompany the plans and specifications. The entire underground conduit system may be listed as an assembly unit in the plans and specifications or each separate component may be listed if desired.

(o) Building Assembly Units

When included as part of the line construction contract standard unattended dial CO buildings may be listed by name or location together with the proper identification as to type and size. REA standard drawings and specifications should be used where applicable. Where special drawings and specifications are required the borrower's engineer or architect should prepare them in conformity with REA standards and submit them for approval with the plans and specifications for the project. Where buildings are not to be included as part of the line construction contract the engineer or architect should prepare a separate REA standard form of construction contract for buildings and submit duplicate copies to REA for approval together with complete plans and specifications for each building, if required.

4. Preparation of REA Form DS-T-10

The detailed study and construction analysis outlined above provides the basis for the preparation by the borrower's engineer of an estimate of the quantities of the various kinds of units of construction required for the construction of the project to be listed on pages C1 to C19, inclusive, of REA Form DS-T-10. The units of construction should be listed according to the standard assembly unit designations as shown on pages d1 to d16, inclusive, of DS-T-10. The quantities shown should conform to the requirements for construction as determined by the detailed study and construction analysis. A "Statement of Construction," similar to REA Form DS-T-27A-B, completely filled out should accompany or be included in each copy of the plans and specifications. The borrower's engineer should refer to the check list attached to Telephone Engineering Memorandum 511 for guidance in completing the information and data required to be shown on the various pages of REA Form DS-T-10 prior to its submission to REA for review and approval. Consistent use of the check list will eliminate omissions and errors and will facilitate the review and approval of the plans and specifications by REA. REA Form DS-T-10, when properly and correctly prepared, forms the body of the plans and specifications for construction of the project. It provides the basis upon which bidders submit their proposals and constitutes the construction contract between the successful bidder and the borrower upon proper execution by the parties thereto and approval by the Administrator. It is, therefore, very important that this document be accurate and complete.

Additional information and instructions as may be required in specific cases can be obtained by consulting the REA Field Engineer or by writing direct to the Engineering Division.

J. K. O'Shaughnessy

J. K. O'Shaughnessy
Chief, Engineering Division

Attachments
Sample Data Sheets 1 to 9

Sample Data Sheet No. 1

CONSTRUCTION ANALYSIS - Project ______________________________

Engineer ______________________ Date ______________________

Summary Loading Zone (   )

Route Miles	Circuits Initial	Circuits Ult.	Conductor Size Type	Pole Top Fixture	Base Pole H-C	Normal Span Length	Ave. Span Length	Poles Per Mile	Total Miles	Total Circuit Contract (Initial)
	Drop Wire and Services									
	Total Route Miles							Total Poles		

Sample Data Sheet No. 2

POLE UNIT QUANTITIES

Project: _____ Date: _____

Base Pole H-C	Total Base Poles	Distribution of Base Pole Quantities to Pole Unit Quantities								
		16-10	16-9							
16-9										
Stubs*										

Total

*Guy stubs should check with number of overhead guy units as determined from summary of guys and anchors, Sample Form Fig. 3.

Sample Data Sheet No. 3

GUY AND ANCHOR ASSEMBLY QUANTITIES

Project: ______________________ Date: ______________

Ult.No. & Type of Cond.	Route Miles	Guys								Anchors						Number Guy Points
		22M		6M		10M		16M		2500 lbs.	4000 lbs.	6000 lbs.	8000 lbs.	10000 lbs.	10000 lbs.	
		D	O	D	O	D	O	D	O							

Total

D= Down guy O= Overhead guy

Note: In the last column show the number of points at which that particular section of line will require guying.

Sample Data Sheet No. 4

POLE TOP ASSEMBLY UNIT QUANTITIES

Project:____________________________ Date:__________________

Pole Top Assembly Units	Total Units	Distribution of Pole Top Fixtures to Assembly Units						
		2BKT	1-2P	1-6P	1-10P	2-6P	1-10P 1-6P	2-10P

Totals

PIN AND INSULATOR ASSEMBLY UNIT (T) QUANTITIES

Project: _____ Date: _____

T Assembly Units	Total Number Units	Distribution of Circuit Contacts to Pin & Insulator Units										Add for Double Arms
		1 Cir	2 Cir	3 Cir	4 Cir	5 Cir	6 Cir	7 Cir	8 Cir	9 Cir	10 Cir	
T-1												
T-2												
T-5												
T-6												
T-7												
T-8												
T-9												
T-10												
T-11												
T-12												
Total Circuit Contacts												

Sample Data Sheet No. 6

WIRE ASSEMBLY UNIT (D) QUANTITIES

D Unit Designations

Project: _____ Date: _____

Number of Circuits	Route Miles	Wire Miles	Route Miles	Wire Miles	Route Miles	Wire Miles	Route Miles	Wire Miles
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Total Wire Miles								
"D" Units								

Note: "D" Units = Wire Miles x 5.28 with 2% allowance for sag and splices

Sample Data Sheet No. 7

DROP WIRE ASSEMBLY UNIT (K) QUANTITIES

Assumed average length of service drop = _____ ft.

K - Unit Designation	Number of Services	Total Length Feet	Number of Units

Sample Data Sheet No. 8

CABLE, LOADING COILS, TERMINALS AND PROTECTOR QUANTITIES

Project: ____________________ Date: ____________________

Unit Prefix C-J-U *	Cable Unit Assembly Designation *	Route Miles	No. of Units	No. of Loading Coils	Terminals					Lightning Arresters		H
					11 pr	16 pr	26 pr	51 pr	101 pr	1 pr	5 pr	units

Totals

* Group cable assembly units to show total quantity of each type of cable assembly unit required
Cable unit = miles of cable x 5.28 with allowance for sag and splices

Thunderstorm days per year ____________

Sample Data Sheet No. 9

STATION EQUIPMENT ASSEMBLY QUANTITIES

Project: _____ Date: _____

CLASSIFICATION OF SUBSCRIBERS: EXISTING AND PROPOSED SYSTEMS*

	Type of Service		Base Rate Bus	Base Rate Res	Rural Rate Bus	Rural Rate Res	Total Existing	Total Proposed
a.								
b.	1-Party	- Existing						
c.		- Proposed						
d.	2-Party	- Existing						
e.		- Proposed						
f.	4-Party	- Existing						
g.		- Proposed						
h.	Multi-Party	- Existing						
i.	8-Party	- Proposed						
j.	Pay Station	- Existing						
k.		- Proposed						
l.	PBX**	- Existing						
m.		- Proposed						
n.	Total	- Existing						XXXXXXX
o.		- Proposed***					XXXXXXX	
p.	Ext. Phones	- Existing						XXXXXXX
q.		- Proposed					XXXXXXX	

* Subscribers listed under "proposed" include all existing subscribers presently served as well as the new subscribers to be served, classified according to the type of service desired from the new proposed system.

** No. of PBX Trunks_____

*** Dial_____, Common Battery_____, Magneto_____

Line	New Station Equipment Required									Existing Sets Used
	Desk Sets			Wall Sets			Bracket Sets			
	Dial	CB	Mag	Dial	CB	Mag	Dial	CB	Mag	
o										
o										
g										
i										
q										
Total										
k										